APPENDIX A

Final Panel Comments

on the

Draft Integrated Feasibility Report and Environmental Impact Statement for Surf City and North Topsail Beach, North Carolina

This page is intentionally left blank.

Final Panel Comment 1:
Based on the information provided in Appendix D (Coastal Engineering) and the Main Report, the study documentation does not adequately describe the development and application of the coastal engineering models, including model calibration, input data, and explanation of results.
Basis for Comment:
Appendix D (Coastal Engineering) describes the development and application of the cross-shore sediment transport (SBEACH), longshore sediment transport (GENESIS), and storm and hurricane economic damage (GRANDUC) models developed by the U.S. Army Corps of Engineers. Previous engineering studies have applied these models, and their capabilities generally meet the study needs. However, Appendix D and the Main Report do not provide adequate or project-specific descriptions of: 1) the model calibration, 2) model input, or 3) model output as evidence that the study properly applied the models or that the models' output provides reasonable results. ***Calibration Details*** Specifically, Appendix D does not discuss any calibration or validation for the GENESIS or SBEACH models (model descriptions in Appendix D, Section 5 [GENESIS] and Section 6 [SBEACH]). Additionally, the study documentation does not indicate if the models applied parameter settings similar to other studies in the region. The apparent lack of a calibration/ validation exercise or reference to the basis for the input parameters seriously limits the confidence in the GENESIS and SBEACH model output. This, in turn, significantly limits the ability to evaluate the recommended project, because the output of these models provides critical input data for the storm damage economic model (GRANDUC) that is used in the formulation, justification, and selection of the recommended plan. ***Discussion of Model Input*** Appendix D and the Main Report do not provide the engineering basis for the Depth Of Closure (DOC) of -23 ft NGVD. Page 153 of the Main Report states "(B)ased on calculations derived from the USACE Coastal Engineering Manual (2002), the calculated Depth Of Closure (DOC) for this study is -7 m (-23 ft.) NGVD." The study documentation does not provide the data sources applied to develop the DOC calculation. Additionally, the Main Report and Appendix D do not mention if any other studies have developed DOC values near the project site to support the value applied in this study. Note that -23 ft may provide a reasonable value, but the reports do not develop or justify the value. ***<u>Review of Model Output</u>*** Appendix D does not indicate if any other prior studies or data sets exist to support the SBEACH and GENESIS modeling results and analysis (e.g., pre- to post-storm volume change during hurricanes, longshore transport estimates in the area, etc.). Neither Appendix D nor the Main Report provides GENESIS evaluation (prediction) of shoreline changes in the without- and with-project conditions. The Main Report and Appendix D do not provide sufficient detail to understand the GRANDUC model results and therefore, the economic damage and benefit modeling. For

example, Section 5.05 of the Main Report does not provide sufficient detail on where the GRANDUC model estimates damages to occur (first row versus second or third row structures) to evaluate the reasonableness of the model output for the non-structural and structural alternatives.
Significance – High:
The lack of detail in Appendix D and the Main Report related to the coastal engineering model development, input data, and output data limits the ability to evaluate the models and could impact the selection or justification of the Selected Plan.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: 1. A description of any GENESIS and SBEACH model calibration/validation efforts completed for the study, in addition to description of the principal input parameters and coefficients. 2. A description of any previous GENESIS and SBEACH modeling efforts completed by other studies near the project area and discussion of model input and parameter values. 3. A discussion of any existing data sets or prior analyses that provide longshore transport or pre- to post-storm volume change estimates that could support the GENESIS and SBEACH model simulations conducted for this study. 4. Use of GENESIS to predict absolute and/or comparative shoreline response from the without- and with-project conditions. 5. Additional details on the depth of closure calculations completed for the study and reference to any previous estimates of closure depth developed for nearby projects. 6. Additional documentation (text, tables, and figures) of the GRANDUC model results to detail where the GRANDUC model estimates damages to occur (first row versus second or third row structures) for the non-structural and structural alternatives.

Final Panel Comment 2:
To justify the scale of the recommended project, additional explanation is needed regarding the formulation of the project's initial and periodic renourishment volume requirements, the predicted response of the project to discrete storm events, and the comparative size and response of corollary projects along this coastline.
Basis for Comment:
Storm Events and Beach Response Neither Appendix D (Coastal Engineering) nor the Main Report describes the physical response of the existing (representative) beach profiles or the recommended project profile to specific storm events. A thorough evaluation and understanding of the plan formulation typically requires graphic illustrations of the pre- and post-storm beach profiles, for both without- and with-project conditions, for discrete storms of various return-period intensity (or, at least for storms of various specified water-levels and wave heights associated with historic storm events such as Hurricane Fran, Floyd, etc.). These graphics, which are not included in the present report, are routinely produced by the SBEACH model and are typically required and expected in similar reports. These graphics are instrumental in understanding the predicted "idealized" physical extent to which the existing and recommended project beach profile may react to, or withstand, storms of various intensities. The project is not formulated to provide protection against a given storm-event frequency, and its storm damage reduction benefits are based upon a probabilistic suite of storm events through the GRANDUC model (not discrete storms). Nonetheless, from the information provided, it is not possible to discern whether the proposed project provides protection from an estimated 10-year event versus a 100-year event. Assessment of the physical reasonableness of the recommended project requires physical description of the predicted project performance, relative to the without-project condition. ***Initial Fill and Renourishment Volumes*** Appendix D, Section 7, notes that 6-year renourishment intervals result in slightly higher computed net benefits but the report accepts a shorter 4-year interval based upon practical considerations. The plan formulation does not make an equivalent evaluation of the initial (design) beach fill. It selects the 1550 plan based upon highest apparent net benefits without practical consideration of the project's overall volume requirements and sand resource availability. The report does not quantitatively describe the basis (computation) of the initial fill requirement, particularly in terms of the design fill and the initial advance nourishment, or the periodic renourishment requirement. It does not appear that any historic data, analysis, or model predictions are presented that describe or justify the selected renourishment volume. It is not clear whether the predicted beach fill volume requirements, for initial construction and periodic renourishment, include the overfill factor (between 1.12 and 1.20, on average, according to Table 7.3) or allowance for direct handling losses during construction. The numeric estimation that the initial renourishment volume is 0.5 times the normal

renourishment volume is potentially low. If losses of the initial construction in Years 1-4 are linear in time, then the initial renourishment requirement in Year 5 is theoretically 0.625 times the normal volume.

Corollary Projects

The report does not present examples or descriptions of corollary projects, or their performance, along the adjacent coastlines, nor of the prior dune or beach erosion control activities along the project shoreline. The Executive Summary (page i) and References (Section 15) indicate that there is a recently completed General Re-Evaluation Report (GRR) for the Town of Topsail Beach (for which the project has not yet been constructed) but there is no description in the Main Report of the recommended project (i.e., dimensions, volumes, costs, status, etc.). Likewise, there is no mention of the scale or performance of the existing nourished beach/dune profile, along adjacent (regional) insular shorelines, including the federal project at Wrightsville Beach (16 miles southwest of the study area, per Section 1.08 of the Main Report). Discussion of the scale of these constructed (and proposed) projects, relative to that proposed in the FR/EIS, would provide a useful means by which to evaluate and understand the recommended project.

Significance – High:

The study documentation provides insufficient data to understand or justify the probable physical performance of the project, the initial nourishment and periodic renourishment volume requirements, and the scale of the project relative to similar regional projects, each of which could impact the project justification or recommendation.

Recommendations for Resolution:

To resolve these concerns, the report would need to be expanded to include:

1. Graphical examples of the expected physical response of the existing beach profile and proposed beach profile to discrete storm events of various, specified intensity (e.g., approximate X-year return event, and/or approximation of Hurricane Bertha or Fran, etc.).
2. Quantified description of the physical basis of the estimated volume requirements for initial construction, including discussion of the design fill and advance fill, the assumptions associated with multi-year initial construction, and allowances for overfill ratio and for handling losses.
3. Quantified description of the physical basis of volume requirements for periodic renourishment, including allowances for overfill ratio and for handling losses.
4. Description of the scale and prototype performance of prior shore protection activities along the project shoreline and corollary (proposed and existing) shore protection projects along regionally located coastlines.

Final Panel Comment 3:
The Selected Plan may not be implementable based on the engineering, construction, and fiscal resources information provided in the FR/EIS.
Basis for Comment:
The Selected Plan is a very large project from perspectives of both cost and total material requirements. The initial nourishment — with a nourishment density of 220 cubic yards per linear foot (cy/lf) — requires over 11 million cy of sediment with four separate nourishments over a four year period to construct. A realistic constraint is that the Selected Plan must prove implementable – both from standpoints of constructability and institutional financial capability. From the constructability standpoint, the documentation presents initial project and renourishment plans that may contain unrealistic expectations on the availability and productivity of dredge equipment in the allotted time frames. The initial construction requires two dredges operating for four seasons of 120-days each, in the winter months, with less than 15% down-time during each 120-day construction season (based upon estimated average production of 14,000 cy/day as described in Section 7.05.1). Further, this construction plan requires that one or more dredges are engaged on the project full-time between December 1 and March 31 for multiple years, and it does not account for the limited availability and competing project requirements of dredge equipment capable of constructing the proposed work. Associated with the constructability of the project, the engineering assumptions regarding the practical availability of sand from the offshore borrow areas are not consistent with standard practice or prototype experience. The offshore sand resource identified (and solely dedicated) for the project does not meet the project's 50-year volume need without the need to rely on sand leftover from other projects (Main Report, page 113) to make up the deficit. This requirement introduces high uncertainty as to whether the available resources can meet the project's 50-year volume need. The identification of a "maximum" theoretical sand volume in the borrow areas that is only 16% greater (Table 7.4 on Main Report page 117) than the projected sand fill requirement provides a low factor of safety to ensure the identified borrow sources can meet the project's total 50-year volume need. It is improbable that the maximum theoretical borrow area volume can be practically dredged, and, conversely, it is probable that the limits of the allowable borrow areas will decrease upon collection of further detailed geotechnical data and possible further restrictions associated with hardbottom impacts. In the event that there is insufficient availability of sand to meet the 50-year project need, it is probable that the cost of identifying and placing sand from future, alternative borrow areas may be significantly greater than the costs ascribed to the identified borrow areas. Further, the Report does not describe if the volume estimates account for uncertainty in future storm frequency and intensity – which could increase beach nourishment requirements. From the standpoint of institutional financial capability, Section 5.01 of the Main Report (page 85) requires that the Plan must be implementable with respect to financial and institutional

capabilities. The estimated total initial construction cost of the recommended project ($118M) is very significant; and the FR/EIS does not adequately address the capability or support of the non-federal sponsors to fund the project relative to other competing project needs. Specifically, Appendix H (Correspondence) does not contain any recent documentation that State or local entities are willing to fund the recommended project beyond the initial investigation. To summarize, the size of the recommended project results in unrealistically high costs, impractical schedule and equipment requirements for initial construction, and insufficient sand resources.
Significance – High:
The assumptions in the FR/EIS regarding the availability and productivity of dredge equipment, the availability of sand in the offshore borrow areas, and the financial and institutional capabilities required to construct the recommended project are questionable or undocumented; and these assumptions are central to the justification and success of the Selected Plan.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to: 1. Provide documentation or discussion that demonstrates the ability to meet the initial project construction schedule with two dredges required for four months (for four consecutive years) during limited winter-time construction windows, and the implications of these requirements upon probable project costs. 2. Provide documentation or discussion that demonstrates the ability and willingness of entities to fund the Selected Plan as outlined in the Main Report. 3. Provide additional discussion on the uncertainty introduced by relying on excess sand identified for other projects in order to meet the selected project's 50-year volume need, in addition to the physical and fiscal effect upon the project's predicted performance if the 50-year sand volume is not available. 4. Provide additional discussion and justification for identifying borrow source material that is only 16% greater than the project's 50-year volume need. Discuss the uncertainty related to extracting material from many different borrow sources with many borrow sources in close proximity to identified nearshore hardbottom areas. 5. Discuss the appropriateness of constraining the project formulation by reasonably available sand borrow quantities and/or total probable costs, similar to existing constraints already imposed by Coastal Barrier Resources Act (CBRA) considerations.

Final Panel Comment 4:
Estimates of property values are potentially incorrect for measuring the economic value of coastal locations.
Basis for Comment:
The FR/EIS uses replacement cost adjusted for depreciation as a measure of benefit for protection of coastal property; this could be an inaccurate measure of individual willingness-to-pay (WTP). Replacement cost only reflects the present value of necessary expenditures to reconstruct a property of similar quality, usually at the original condition level. Land on barrier islands is scarce, and competition among buyers and sellers can be significant. When market demand is strong (as has been the case on the east coast for the past 10 – 15 years, last couple of years excepted), market values can exceed replacement cost, as coastal parcels earn scarcity rents. Competition will affect the value of land more than structure, but since the two are linked, market structure values can exceed replacement cost. Thus WTP can be best approximated by the market value of coastal property less the land value; regression analysis (hedonic property price analysis) can be used to net out the value of the land from the structure. In particular, a properly specified regression model can be used to estimate current market value, can be used to estimate the value of a vacant lot (if there are data on lot sales), and can predict the change in housing value associated with changing characteristics (Landry, Keeler and Kriesel 2003; Parsons and Powell 2001). Alternatively, assessed values (from tax collector records) can be used as a proxy for market values. Assessed values are usually measured at a common point in time (e.g., all reassessments done at the same time), so as long as recent estimates are available the complication of estimating current value is not a problem. Also, assessments are usually broken into land and structure value. Regression analysis can be used to adjust assessed values for changing property characteristics, as suggested above. Thus, if possible, market or assessed property values should be used in the FR/EIS benefit-cost analysis. If replacement costs adjusted for depreciation are to be used for benefit-cost analysis of coastal protection, the analysis should provide a justification for this decision. The use of replacement cost could be justified as a lower bound on true economic value. In the panel's opinion, justification of depreciation is more difficult to make. If the housing stock is old, depreciated replacement costs may value many parcels at close to zero dollars (depending upon the age of the structure and depreciation method employed). Clearly, value estimates can be very different from market value under these conditions. The analysis should address this potential problem, perhaps by including a comparison of replacement costs to market (or assessed) values. Moreover, the discussion needs to include details on replacement costs calculations, specifically addressing the method used to estimate replacement cost, the method used to depreciate replacement costs, and the chosen depreciation rate. The additional use of assessed or market values in benefit-cost analysis, however, would provide valuable sensitivity analysis for the FR/EIS. The use of interior land values as a measure of lost economic value due to oceanfront erosion is an appropriate assumption, as amenity value can be transferred (e.g., second row home

becoming beach front increases the value of that home) under the condition that the hedonic property price relationship is stable under changing management regimes (e.g., non-structural option) or changing risk perception (e.g., climate change and sea level rise) (Landry, Keeler and Kriesel 2003; Parsons and Powell 2001). Lastly, neither Section 3.08 in the Main Report nor Appendix B quantifies the number of structures and the total baseline value (land, contents, and structure) for the "oceanfront" row versus the "second" row and/or other interior rows. Likewise, the projected without-project damages, and with-project benefits, are not separately itemized for the oceanfront and interior rows. Without this separate accounting, one cannot judge the reasonableness of the GRANDUC model results.
Significance – High:
Property value estimates play a prominent role in project justification and could impact the determination of whether coastal protection is economically efficient and plan selection.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: 1. Additional analysis that employs market or assessed values (possibly with hedonic price analysis) <u>or</u> a clear justification and defense of the use of replacement costs. 2. Sensitivity analysis to the use of particular property value estimates (e.g., replacement cost compared to market values or assessed values, replacement cost with and without depreciation, etc.) 3. More details on property values; for example: - It would be useful to know how many structures are being valued in each reach (tables 3-B, B-16 & B-17). - Separate quantification of the number of structures and total baseline value (land, contents and structure) modeled along the "oceanfront" row versus the "second" and/or other interior rows. - Separate quantification of the without-project damages, and with-project benefits, predicted along the "oceanfront" row versus the "second" and/or other interior rows.

Literature Cited:

Landry, C.E., A.G. Keeler and W. Kriesel. 2003. An Economic Evaluation of Beach Erosion Management Alternatives. *Marine Resource Economics* 18(2): 105-127.

Parsons, G.R. and M. Powell. 2001. Measuring the Cost of Beach Retreat. *Coastal Management* 29: 91-103.

Final Panel Comment 5:
The benefits associated with the non-structural alternative may have been underestimated or not fully evaluated, and the spatial distribution of benefits is unclear.
Basis for Comment:
The non-structural alternative involves retreat, relocation, and demolition of threatened properties. The determination of costs associated with retreat/relocation/demolition, the choice among these options, and the optimal timing of the choice needs to be better explained. And, recognizing the uncertainty and potential difficulties associated with a non-structural option, the evaluation should include sensitivity analysis in order to assess the effects of critical assumptions. Appendix P provides details on the analysis of the non-structural alternative. The discussion indicates that unbuilt oceanfront lots are assumed to be fully developed before initiation of the protection project. This assumption seems significant and potentially unwarranted, given that future development likely hinges on expectations of coastal protection (i.e., people are more likely to develop oceanfront parcels if they believe they will be protected from erosion, and they are unlikely to develop if they expect their house will be condemned shortly thereafter). According to the maps in Appendix A, there appear to be only about 610 existing structures along the oceanfront. The analysis of the non-structural option should be based on the current level of oceanfront development (at least to provide a comparison to evaluate the impact of the assumption of full development in intervening years). Initial estimates suggest that the retreat option has limited potential in the study area, due to small lot sizes and the presence of a roadway behind the first row of houses. Thus, relocation and demolition appear to dominate the exercise of the non-structural option. The appendix suggests that the least costly of these two options is the alternative chosen. More details, and perhaps some examples, would be useful in helping the reader to understand the types of tradeoffs that are made in assigning structures to relocation or demolition. Relocation is limited by the availability of lots in the study area. The analysis assumes that only 1/3 of current vacant lots will be available. This assumption, too, may be unwarranted and should be evaluated through sensitivity analysis. A comparison study should be conducted to see how the costs of the non-structural option might change if more vacant lots were available. Table 5.1 in the FR/EIS suggests that there are 615+289 = 904 structures subject to demolition and relocation/retreat. The relationship between the 739 lots to be purchased and relocated/demolished relative to the figure in Table 5.1 (904) is unclear. Also, it is not clear whether there is uncertainty in the relocation cost estimates. If so, the analysis could examine high and low estimates in order to ascertain the sensitivity of net benefits to uncertainty over implementation costs. Real estate costs associated with the non-structural option include oceanfront land acquisition. The analysis uses a constant value of $500,000 per lot, but could be modified to employ the assessed lot value. This may provide for more realistic cost estimates. Moreover, the cost of land acquired to relocate homes is also assumed to be $500,000 per lot, but this is likely to be an overestimate of the cost of acquisition, as these lots are not oceanfront. The analysis should

include a more realistic estimate for relocation costs.

The non-structural alternative is assumed to initiate in year one of the project, but many of the threatened structures could have useful economic life beyond this time period. The analysis makes no attempt to optimally target the timing of the exercise of the non-structural option, presumably for simplicity. The analysis could be significantly improved if a better timing rule could be devised (e.g., exercise non-structural option when structure is within X feet of mean high water line). Such a timing rule would likely delay many of the costs associated with the non-structural option, which could make it more economically attractive.

The evaluation of the non-structural alternative in terms of storm damage reduction benefits presents results that appear suspect. From Table 5.1, the Present Worth benefit of "removing" the oceanfront structures is projected as $135M. However, from Table 3-4, even if land damages are removed, the present worth value of structure damages in the "without-project" condition is about $329M. Thus, the apparent benefit of eliminating all of the oceanfront homes is only 135/329 = 41% of the projected without-project structure damages. This result implies that the other 59% of the without-project, 50-year structure damages are predicted to accrue to the second, third, and other interior row structures; that is, the great majority of damages are ascribed to non-oceanfront structures. This proportion seems abnormally high. Instead, given the described nature of the existing development, the setback of the second row and interior structures, and prior corollary experience, one would expect that the vast majority of predicted damages would accrue to the oceanfront structures.

Lastly, the projected recreational benefits associated with the non-structural alternative could be inaccurate. Most important is that no recreation benefits are included for the non-structural plan (page 88 of FR/EIS). Retreat/ relocation/ demolition could improve beach conditions, and provide an amenity that might be considered more "natural" by visitors. Removing threatened structures would allow adaptation to natural shoreline processes, which could produce better beach quality and greater useable beach width for recreation relative to no-project conditions. Since the recreation benefits analysis of the 1550 plan includes benefits due to increases in beach width (see Appendix O, page O-19), it would seem feasible to conduct a similar analysis for beach width and the non-structural alternative. Beach width is likely to diminish slowly over the next decade, so the recreation benefits of the non-structural plan would likely diminish slowly over time. There is existing research that suggests the non-structural option (referred to as "shoreline retreat" in the literature) could result in improved beach conditions and that recreational users may value the changes associated with this type of policy (Daniel 2001; Kriesel, et al. 2005; Landry, et al. 2003). It is thus not clear that non-structural option would reduce recreational visitation and income (Table 7.14, page 134).

If the non-structural option does not protect road infrastructure, then costs should include expenditures necessary to maintain transportation infrastructure.

Significance – High:

Accurate evaluation of a non-structural alternative is an important part of the FR/EIS, as many skeptics and critics of conventional beach management claim that non-structural approaches are cost effective. In order for the FR/EIS to maintain objectivity, the non-structural alternative needs to receive an evaluation that recognizes its uncertainties, and that is consistent with the

assumptions about benefits and costs in the other alternatives.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: 1. More details on range of costs for non-structural options and sensitivity analysis on the level of costs, including details describing the ultimate number and locations of structures assumed to be demolished or relocated. 2. More details, and perhaps some examples, indicating the factors that influence how structures are allocated to retreat, relocation, or demolition. 3. Optimal timing for exercise of non-structural alternative at the parcel level (or if this cannot be done, an explanation of the problems in implementation of phased or a "retreat as warranted" approach). 4. Sensitivity analysis to the assumptions used in evaluation of the non-structural alternative, including: - The level of oceanfront development in the initial year of the project - The number of vacant lots available for relocation - Acquisition costs for non-beachfront relocation land (employing lower estimates than currently used) 5. Interpretation of the distribution of storm protection benefits implied by approximately 59% of protective benefits accruing to second and third row houses. 6. A re-evaluation of the assumption that recreational benefits associated with the non-structural option are zero.

Literature Cited:

Daniel, H. 2001. Replenishment versus retreat: the cost of maintaining Delaware's beaches *Ocean & Coastal Management* 44(1-2): 87-104.

Kriesel, W., C. Landry, and A. Keeler. 2005. Coastal Erosion Management from a Community Economics Perspective: the Feasibility and Efficiency of User Fees *Journal of Agricultural and Applied Economics* 37(2): 451-61.

Landry, C.E., A.G. Keeler and W. Kriesel. 2003. An Economic Evaluation of Beach Erosion Management Alternatives. *Marine Resource Economics* 18(2): 105-127.

Final Panel Comment 6:
The presented geotechnical data are either incomplete or indicate that the proposed borrow sites are not well-suited to meet the requirements and predicted performance of the Selected Plan from engineering, economic, and environmental standpoints.
Basis for Comment:
The FR/EIS conclusions regarding the probable cost and amount of sand available from the offshore borrow areas requires that the borrow areas be dredged to within about 16% of their theoretical estimated cumulative volume in order to yield the 50-year project requirement, and additionally requires dependence upon “left-over” material in borrow areas designated for other projects, over which the project may have limited control. It is not clear if the 50-year project volume fully accounts for both overfill and handling losses. The geotechnical data are very limited in scope and likewise suggest that the ultimate amount of retrievable sand from the borrow areas may be significantly less than the estimates – owing to (a) the shallow depth and irregular nature of the deposits, and (b) proximity and potential impacts to hardbottom. Specific observations include the following. 1. From an engineering standpoint, a 16% allowance (margin) between the project’s total material requirements and the estimated borrow-area resources is typically considered to be unacceptably small, particularly when the latter assumes that the borrow areas must be cut to their theoretical limits and they will not be subject to further reductions. 2. The estimated borrow area volumes are based upon limited core-borings, many of which are located in areas that will be excluded as buffers for hard-bottom. The data for many of the discrete borrow areas comprise limited or no core data, and some exhibit layers of very fine material. For example, only two cores are shown for Borrow Area E and both appear to be located in a hard-bottom buffer zone which is apparently excluded from dredging. Table 7.3 lists a 0.23 mm grain size for Borrow Area E, but this value is based only upon the cores located in exclusion zones. The estimated 720,000 cy yield of Area H is based upon only 2 cores. 3. In many instances, the underlying stratum (below the identified borrow area source) is either not identified, presumably rock, or contains unsuitable material. A buffer is not identified above these strata. For example, Borrow Area J, Core TI-03-V-270A, ascribes a 2-ft borrow depth of -46.3 to -48.3 feet. Immediately below this is fine-grained (0.11 mm), high-silt (17.7%) sediment that is not beach compatible. The minimum 2-ft vertical buffer that would be normally assigned atop this incompatible underlayer would wholly obviate the 2-ft thick potential borrow lens – thus eliminating any yield from this zone of Borrow Area J. Similarly, some cores suggest hard stratum immediately below the ascribed borrow-area depth; and it is not reasonable to assume that the dredge can cut neatly to this stratum. The tentatively identified borrow areas will not yield the theoretical “neat-line” volumes that are ascribed to them, especially in this case of shallow cuts, irregular borrow area planforms, and the potential presence of rock. Requirements of at least some minimum buffer between the suitable and non-suitable material would exclude a significant fraction of the theoretically available borrow area volumes. 4. In terms of compatibility, the analysis of the borrow area grain size includes data from cores that are within probable exclusion (no-dredge, buffer) areas. These cores typically contain

coarser material that biases the composite borrow-area granular data toward unrealistically coarser values. For example, Borrow Area "L" includes 10 core-log summaries, of which three cores are in "high-relief" buffer zones and depict some of the coarsest sand in the borrow area. Without these three cores in the apparent no-dredge area, the composite mean grain size ascribed to Borrow Area L is finer than that listed in Table 7.3 (i.e., 0.214 mm versus 0.24 mm). Thus, the tabulated summary of the preliminary grain size data – and overfill factors – appear to be non-conservative. It is reasonable to conclude that the borrow area grain sizes will likely be smaller, and the overfill-factors and sand borrow requirements will likely be greater, than the values in the FR/EIS, particularly after further requisite data are collected.

5. Section 7.03.1 states that the requisite fill volumes include 12% additional placement to account for "placement losses." This does not clarify between "overfill-factor requirements" for sand compatibility and "losses" during construction. The mean value of the overfill factor (neglecting Borrow Area C) from Table 7.3 (p. 116) is 1.12. Including the correction for silt fraction, the mean value of overfill is 1.20. Hence, the minimum requirement for beach fill placement is at least 1.12 to 1.20 times greater than the residual "in-place" requirement; and, the requirement for borrow area dredging is greater than these amounts to account for losses during the construction process (typically 5% to 10%). Hence, a 1.12 allowance for "placement losses" might minimally account for the overfill factor, but it does not account for dredging losses. Thus, the actual dredging requirements at the borrow area are expected to exceed the values specified in the report, once handling losses are added. This further reduces the 16% margin between the project's estimated 50-year requirements and available borrow area volumes.

6. From an economic standpoint, the predicted dredging costs appear consistent with those of a "typical" offshore borrow area that is relatively unencumbered by hardbottom and irregularities. The FR/EIS does not appear to take into account the higher dredging costs that are reasonably associated with the project's increased difficulty and risk: shallow, irregular cuts often underlain by hard strata or unsuitable soils, proximity to hardbottom, potential for suspensions due to sedimentation, and the large distance between the borrow areas and harbors of refuge.

7. Initial screening and optimization of the beach fill alternative plans assumed that sufficient sand quantities were available for all alternatives, at identical unit costs and single-year initial mobilization costs. This assumption, which is not supported by the information in the FR/EIS, influenced selection of the recommended plan.

8. From an environmental standpoint, identification of borrow area limits (toward achieving a total 50-year project requirement) requires minimization of all buffer distances relative to adjacent hardbottom. It is likely that future requisite surveys will identify additional hardbottom that will further limit (reduce) the available borrow area resources. USACE's commitment to monitor potential dredging impacts to hard-bottom and to alter dredging actions if needed – as described in Section 8.01.8.2 of the Main Report – greatly increases the likelihood that portions of the proposed borrow areas will be limited or excluded from dredging. This situation would further reduce the 16% margin between the project's estimated 50-year requirements and available borrow area volumes.

Significance – High:
The Report's conclusion that the offshore borrow areas are sufficient to provide for the project's 50-year volume requirements is not justified by the data that are presented.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: 1. Re-computation of the probable sand volume plausibly available for extraction from the borrow areas based upon the available geotechnical data, taking into account reasonable buffers above non-suitable material and hardbottom, allowances for imperfect extraction from irregular borrow areas, and potential for borrow area reductions associated with additional hardbottom areas or impacts to hardbottom. 2. Justification that the predicted costs of dredging reflect the risks and difficulties associated with the irregular borrow areas and hardbottom proximity, and/or graduated increase in future dredging costs to reflect increasing complexity and risk of dredging as resources within the borrow areas are depleted. 3. Alternative computation of the apparent overfill ratio requirements based upon existing data, exclusive of data from cores within hardbottom exclusion areas. 4. Quantified description of the extent to which the total anticipated volume requirement from the borrow areas includes specific allowances for overfill ratio and for losses during dredging and placement. 5. Justification that a 16% allowance between the project's total material requirements and the estimated borrow-area resources provides a reasonable buffer should the project need additional material or resources become unavailable. 6. Plan formulation with a constraint that limits the 50-year volume requirement of the project to that which is reasonably available from the dedicated project borrow areas, subject to consideration of the issues raised above.

Final Panel Comment 7:
The justification for developing and applying the historical shoreline erosion rate, as presented in the FR/EIS, needs more detail.
Basis for Comment:
The plan formulation and evaluation appears to rely upon annual shoreline erosion rates (for the without-project condition) developed by comparing a 2002 shoreline survey with a 1963 USACE survey of Topsail Island, as described in Appendix D, Section 4. Reliance upon only two data points (i.e., an “end-point analysis” between 1963 and 2002) can lead to either survey having a significant effect on the results. Appendix D does not describe the surveys’ potential limitations nor does it describe the conflict between these two surveys’ results and the only other shoreline-change rates that are presented (i.e., from North Carolina Division of Coastal Management [NCDCM]). The months of the 1963 and 2002 surveys are not given. Seasonal differences may influence the conclusions drawn from comparison of two surveys from different seasons. The report does not clarify or indicate the degree to which the 2002 beach profile surveys were influenced by prior anthropogenic activity (dune fill, beach scraping, etc.) or immediate-preceding storms. It is not clear how the 1963-2002 historical shoreline erosion data are directly used in plan selection and evaluation. Appendix D, page D-26 (item 2e.3) implies that a long-term erosion rate for each project reach is input to GRANDUC, but the erosion values and their application (through time and for various alternative analyses) are not specified. The average annual rate of historical shoreline change cited in the report (from the 1963-2002 comparison), ranging from 1 to 2 ft per year along the project area, is a modest erosion rate relative to the 220 cy/ft initial fill of the recommended plan. In fact, the only other historical data that are presented (from NCDCM, Figure D-6) suggest that the shoreline exhibits a long-term trend of stability and accretion. The latter is more consistent with the results of the net longshore transport predictions from GENESIS, illustrated in Figure D-7. The effect upon the project’s formulation of a 1 to 2 ft per year (without-project) erosion rate based upon the 1963-2002 data – versus an assumption of shoreline stability from the NCDCM data – is not evaluated or described in the Main Report or Appendix D.
Significance – High:
The development and application of the background erosion rate can significantly affect the predicted benefits and scale of the selected plan.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: 1. Discussion of the timing and potential limitations of the 1963 and 2002 shoreline surveys and their sole use to define the long-term shoreline change rates. 2. Discussion of the conflict between the 1963-2002 shoreline erosion rates and the stability/accretion described by the NCDCM data (and implied by the GENESIS longshore transport predictions). 3. Sensitivity evaluation of the project’s predicted benefits as a function of the assumed shoreline change rate; e.g., benefit calculation using a null erosion rate.

Final Panel Comment 8:
The proposed geometry of the berm and dune appears inconsistent with natural beach profiles.
Basis for Comment:
In Section 5.03 of the Main Report, the plan formulation considers a flat low berm, with or without a dune feature. Neither the flat berm nor proposed dune-face slope of 1(vertical): 10(horizontal) appear to be consistent with natural beach profiles, including the representative profiles presented in the Main Report. Justification for these project geometries is not presented. More “typical” beach geometry with natural (steeper) dune slopes and slightly higher (sloping) berm elevations, not considered in the initial project scoping, may provide adequate storm damage reduction with slightly lesser fill requirements and improved long-term project performance relative to the Selected Plan. The beach fill plan formulation assumes a flat, low berm at +7.0 ft NGVD because of concerns for scarping (Section 5.03, page 86). Inspection of the representative profiles (Figures 3.3 and 3.4) and corollary experience suggests that a berm elevation of +7 at this location is reasonably expected to be subject to frequent overwash, ponding, and erosion. Because a flat berm is not consistent with a natural beach berm, consideration might be normally made of a berm which slopes gently from +7 ft at its seaward edge to some slightly higher elevation (for example, +9 ft) at its landward edge. This is a “turtle friendly” profile, commonly implemented in Florida by the USACE Jacksonville District and others, which acts to prevent overwash, ponding, and wave attack of the dune-toe and vegetation, while minimizing the potential severity of escarpment formation. The proposed dune slope of 1v:10h is not consistent with the dune slope of the existing profiles and traditionally observed natural dunes, both of which are about 1v:3h. Instead, the proposed 1v:10h slope is more emulative of the beach-face slope that exists below the berm and into the sea. Adoption of a 1v:10h dune slope results in a dune geometry that encroaches significantly upon the berm and is therefore prone to more frequent erosion from storm waves; and, it results in an overall design beach that is much wider (and which requires significantly greater initial fill) than traditional designs with a 1v:3h dune slope. Specifically, the proposed 1:10 dune slope between +15 and +7 elevation occupies 56-ft greater width than a traditional 1:3 slope. This contributes to an overall beach width in the Selected Plan that appears to be considerably wider (i.e., located substantially more seaward) than the historically recent, natural location of this shoreline, based upon the Main Report’s assumption of a 2 ft/year shoreline erosion rate. Likewise, establishment of a dune and vegetation across a 1:10 dune-face slope (versus the natural and traditional 1:3 slope, with a slightly higher landward berm edge) increases the requirements (and associated costs) for vegetation planting and new dune walkovers by over 50%. Additionally, establishment of dune vegetation on the proposed dune-face slope of 1:10 may likely result in greater potential human disruption of the dune feature and vegetation – because the gentle dune slope will appear as part of the upper beach – in addition to greater potential erosion impact, because the dune toe is significantly closer to the seaward edge of the proposed low, flat berm.

Significance – High:
Consideration of berm and dune geometries (elevations and slopes) that are more emulative of existing and natural beach profiles and modern “turtle friendly” designs may result in a more optimum project design that provides improved long-term performance.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: 1. Consider alternative design geometries that emulate natural (steeper) dune slopes and slightly higher, sloping berms that may potentially offer greater resistance to scarping, overtopping, dune-toe erosion, and which are consistent with turtle-friendly designs. 2. Likewise, the initial scoping analysis should consider at least one hybrid design (steeper dune slope and slightly higher, sloping berm) beyond the existing scoping consideration of only the flat berm with and without an unnaturally wide dune feature.

Final Panel Comment 9:
The recreation benefits analysis omits overnight users, lacks an explanation for selecting the contingent valuation benefit estimate over the travel cost benefit estimate, and omits a discussion of congestion, all three of which can be addressed with existing project data or literature.
Basis for Comment:
Recreation benefits represent about half the total project benefits, yet there are several important limitations to an otherwise very competently done analysis. The first possibly significant limitation is the analysis' focus only on day users to the exclusion of overnight users, even though a significant portion of overnight visitors may be on single destination trips. Omission of this type of overnight visitor will underestimate total recreation benefits from beach restoration. The second important issue relates to choice of Contingent Valuation Method (CVM) benefits per visitor day instead of Travel Cost Method (TCM). Discussion in Appendix O on pages O-10 and O-11 indicates the TCM benefit estimates contain only the value of visiting the site-specific beach, while the CVM benefits gives the total of both the value of visiting any beach in the study area plus the value of visiting the specific beach in the study area. This implies that the TCM benefits are the site-specific values attributable to the study area beach, and therefore appropriate to use rather than the CVM. Use of the CVM benefits would overstate recreation benefits by as much as a factor of ten. Third, on-site sampling frequently results in an avidity bias associated with more avid users being oversampled. This can result in an overstatement of benefits. Fourth, as predicted in the Main Report, visitor use will increase with restoration relative to the no project alternative, yet there is little attention paid to the effect of increased visitation on beach congestion. Increasing beach congestion could reduce per visitor day benefits to below what they are now. Hence simple multiplication of existing benefits per day times future increased visitation is likely to overstate future total recreation benefits. Fifth, comparison of increased peak visitor use to planned increases in parking facilities should be made so as to discuss whether even the new parking facilities would be able to meet the new higher peak time periods visitor demand. Some of these problems may be fixable with existing data (as described below), and others should at least be acknowledged so the reader knows that USACE recognizes the limitations in the recreation demand and benefit analysis. These changes are needed to make the analysis more consistent with good practice in the field of recreation benefit analysis and more clearly convey these in Appendix O and Chapter 7 of the FR/EIS.
Significance – Medium:
Since recreation benefits represent about half the total project benefits, taken together, addressing the first three concerns could have substantial effect on the magnitude of the recreation benefit estimates. Addressing the fourth and fifth concern will improve the completeness of the report.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: 1. Include single destination overnight visitors in the recreation benefits analysis and provide details on their relative contribution to total visitation or provide a strong rationale for solely focusing on day users and omitting single destination overnight visitors. Thus, the first correction is to report in Appendix O and Chapter 7 (Section 7.08) the proportion of visitors intercepted at the study area beaches that were day users from within 120 miles (the group included in USACE's analysis), day users from beyond

120 miles, overnight users within 120 miles, and overnight users beyond 120 miles. This provides the reader with perspective on what proportion of total visitors are reflected in the USACE's visitor use and benefit estimates. If data in the survey exist that identify whether an overnight trip was single destination or not, then single destination overnight trips should be included in the benefits and use estimates. At a minimum, elaborating on the statement on page O-17 (and adding it to Chapter 7 (Section 7.08)) that 70% of the day trips are included and what proportion of total use is omitted is required. If it is not feasible to include single destination overnight visitors, then an acknowledgement should also be added to page O-17 and Chapter 7 that omitting overnight visitors results in an underestimate of total recreation benefits.

2. Detailed explanation for the reliance upon CVM benefit estimates rather than TCM benefit estimates. Based on the discussion on Page O-10 & O-11, which suggests that the TCM benefit estimates contain only the value of visiting the site specific beach and the CVM benefits do not, the Panel recommends that: (a) TCM benefit estimates be used rather than CVM; or (b) better justification for using CVM estimates instead of TCM be made in Appendix O.
3. Discussion of issues surrounding beach congestion. Appendix O and Chapter 7 do not mention the impact of increased visitor use resulting from increased beach width and addition of parking spaces on beach congestion. While a complex topic to address empirically with this data and in this FR/EIS, it should be acknowledged that past research (McConnell, 1977) indicates that increased visitor use can reduce the benefits per visitor day if number of visitors per acre rises.
4. Correction for or acknowledgement of problem with an on-site sampling of visitors. While on-site sampling is the most cost-effective way to obtain recreation valuation data, the resulting data and benefit estimates are likely influenced by "avidity" bias or technically, endogenous stratification. This causes problems when the phenomenon under study varies with avidity (as economic value does). Ideally, the TCM estimates of benefits could be corrected for this problem (employing inverse probability weights) (see, e.g., Thomson, 1991), but at a minimum this limitation acknowledged and that the benefit estimates from TCM may be slightly over-estimated.
5. A more complete discussion of basis for recreation benefits in Chapter 7 (Section 7.08). The one short paragraph describing the basis of the $20 million in recreation benefits (half the project benefits) is inadequate to convey the methods and data to most readers. The term contingent valuation needs to be described in 2-3 sentences and the estimated visitor use levels underlying the $20 million with-project benefits stated. The omission of the visitor use estimates (or at least proportions) also needs to be noted.
6. More complete presentation (perhaps including graphs) of how well the expanded parking facilities meets peak visitor demand associated with forecasted increased visitation, assuming the same proportion of the new total visitation comes during peak time periods as current temporal pattern of existing visitation.

Literature Cited:

McConnell, K.E. 1977. Congestion and Willingness to Pay: A Study of Beach Use. *Land Economics* 53(2): 185-195.

Thomson, C.J. 1991. Effects of the Avidity Bias on Survey Estimates of Fishing Effort and Economic Value. *American Fisheries Society Symposium* 12: 356 – 366.

Final Panel Comment 10:
The cost estimates need more detailed explanation, including the rationale for calculating interest during construction.
Basis for Comment:
The FR/EIS makes use of cost estimation software and appears to employ some standard USACE practices with regard to costs. The details of cost and the procedures employed, however, can be difficult to follow. For example, in Appendix N, the estimates on pages 6-14 are difficult to understand. The units of measure (UOM) are never defined (e.g., abbreviations: CY – cubic yards?, APR, EA). Nourishment costs [ACCOUNT 17] appear to be based on historical estimates. It is not clear what the bases for Planning, Engineering, and Design [ACCOUNT 30] or Construction Management [ACCOUNT 31] are. (Appendix N, page 5) At numerous points in the FR/EIS, reference is made to calculation of interest during construction. The rationale for this interest calculation is never made clear. It could be an attempt to measure opportunity costs of capital (if so it should only be applied to the value of capital assets) or could reflect funds tied up during the construction phase of the project, which must be compounded forward to a present value at the beginning of the operational life of the project. In any event the FR/EIS should make clear what this calculation is meant to accomplish. There may be a USACE guidance document that establishes these calculations as standard practice, but if so one is never referenced. The rationale for the procedure should be explained.
Significance – Medium:
Clarification and explanation of cost estimation will enhance understanding and lend credibility to the analysis.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: 1. Rationale and references (as appropriate) for the "interest during construction" calculations. 2. Additional details on units of measure and the basis for cost estimates.

Final Panel Comment 11:
The study documentation should indicate the degree to which anthropogenic replenishment and prior storm impacts have influenced the representative beach profiles applied in the SBEACH and GRANDUC models.
Basis for Comment:
The engineering and economic analyses require the proper development of representative profiles for application in the SBEACH and GRANDUC models. The Main Report and Appendix D (Coastal Engineering) do not provide adequate discussion of the methods and beach profile data applied to develop the representative profiles. For example, the Main Report and Appendix D do not indicate if or how the development of the representative profiles considered recently nourished or post-storm profiles. The Main Report provides a plot of all representative reach profiles in Surf City (SC1 – SC8) and North Topsail Beach (NTB1 – NTB8) — Figures 3.3 and 3.4 on Main Report pages 76 and 77. However, the Main Report and Appendix D do not include plots or discussion of measured profile data within each representative reach to confirm similarity of general beach profile geometry and features within each specific reach. Additionally, the Main Report and Appendix D do not provide adequate discussion of existing or prior shore protection actions along the project shoreline. Main Report Section 3.06 (page 75) makes mention of large dune reconstruction after Hurricane Fran in 1996, and there are photographs of beach scraping; but the number, frequency, order-of-magnitude volume, locations, and success of prior beach nourishment (or related) activities along the project area are not described in the report. There is no discussion of historical changes to the dune (i.e., width, seaward location, etc.), which largely influences the vulnerability of the island's infrastructure to storm damages. The report does not depict a "natural" (possibly historical) beach profile in the broad vicinity of the study area, potentially unaffected by prior anthropogenic actions or 1996-99 hurricane impacts. The report states that the dune has little crest width, steep side slopes, and that the berm is narrow (Section 3.06, page 75); however, it presents no historical or natural dune/beach profile context by which to assess the existing representative profile(s) or proposed restoration.
Significance – Medium:
The lack of detail in the discussion of the representative profile development limits the understanding of the profiles applied in the SBEACH and GRANDUC models and limits evaluation of the model's output.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: 1. A more complete discussion of the profiles applied and the procedure followed to develop the representative profiles. This discussion should provide details on how the method considered recently nourished or post-storm profiles. 2. A discussion of existing or prior shore protection actions along the project shoreline. This discussion should include available information on prior project activities and their performance. 3. A discussion of how prior storms have specifically changed the dune and berm

conditions in the project area, and/or depiction of “natural” dune and berm conditions in substantial absence of anthropogenic or recent hurricane impacts.

Final Panel Comment 12:
Local data sets and prior analyses on longshore sediment transport, wave height, and background erosion rate have not been fully discussed.
Basis for Comment:
Appendix D does not contain a complete discussion of available local data sets or prior analyses completed for coastal processes in the project area. Notable areas needing further discussion or analysis include: • Data on seasonal and yearly variation in wave records are needed to evaluate the longshore transport in the project area. The Main Report 2.03.1 (Page 55) provides only text that summarizes the Wave Information Study (WIS) wave record. • The implications of the alongshore convergence of the longshore sediment transport (from GENESIS modeling) versus the conflicting observations of accretion (NCDCM data) and erosion (1963-2002 data) from the two different shoreline change analyses are not discussed. Appendix D does not explain why there is no accretion (or beach stability) demonstrated and/or predicted along this convergence zone, even though shoreline accretion is clearly indicated in the NCDCM shoreline change rates (Figure D-6). Instead, the report appears to indicate or presume that this area of convergence is eroding, like the adjacent shores, at 2 feet per year, and will continue to erode in the future. • The longshore sediment transport rates were apparently developed from GENESIS, but with apparently no allowance for nearshore bathymetric (non-parallel) contours and with no discussion of calibration. Only net transport rates are presented, with no discussion of gross rates. • There is no depiction or discussion of nearshore bathymetry, contours, or historical changes in the nearshore contour locations. • The Main Report and Appendix D provide no volumetric erosion analysis. This analysis could provide justification for the large initial nourishment density (>220 cy/ft) and renourishment volume requirement.
Significance – Medium:
The lack of detail in the sections that highlight local data sets and prior analyses conducted affects the completeness of the report and limits the ability to understand and verify analyses completed during the study.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: 1. Additional information on the seasonal and yearly variation in wave records in the project area. It is unclear if the yearly variations in wave data appear in the yearly GENESIS results. 2. Discussion of the convergence of longshore transport demonstrated in the GENESIS modeling results and the NCDCM shoreline change estimates and the implications to historical shoreline change and expected project performance. 3. Discussion of local bathymetry in the project area and if the GENESIS model assumption of generally straight and parallel offshore bottom contours proves valid. 4. Discussion of any apparent large scale historical changes in the offshore bottom contours. 5. An analysis of historical volumetric change in the project area based on available data.

Given sufficient data, the volumetric analysis should define a long-term period and also a short-term (storm) period.

Final Panel Comment 13:
Additional risk and uncertainty analysis is necessary to address the assumptions and inherent variability in project costs, property values, climate change, and recreation.
Basis for Comment:

A review of Section 7.10 of the Main Report on Evaluation of Risk and Uncertainty (RU), along with Appendices B (Economics) and D (Coastal Engineering) suggests that significant sources of uncertainty were not formally itemized and evaluated for likelihood of occurrence and/or impact to the project's predicted outcome. Likewise, these sources of uncertainty do not appear to have been included in the GRANDUC model, or they were added as a constant fixed amount to the results of the GRANDUC model runs. These elements of risk include uncertainty over dredging costs, recreation benefits, and property values.

Page 31 of Appendix B states that the recreation benefits analysis had not been completed in time to include in the GRANDUC model and was added external to the model runs. It is not clear if this means that uncertainty in recreation benefits was considered or not. Since recreation benefits represent half the project benefits, and there is statistical variability in these benefit estimates (e.g., value per day and number of visitor days) and GRANDUC can incorporate recreation (page 31 of Appendix B), sensitivity of net project benefits to uncertainty in recreation benefits is important.

Risk/uncertainties regarding project costs also appear to have been omitted from the GRANDUC analysis, or at least, appear not to have been specifically evaluated. These uncertainties include:

- Impacts to project (dredging) costs, particularly related to the estimated amount of available sand in the borrow areas.
- Degree of complexity (increased cost) associated with the shallow-cut and irregular geometries of the borrow area.
- Likelihood that sufficient dredge plant will be available to construct the project within the tight environmental windows in light of competing nationwide project requirements (another reason that opportunity costs of capital should be included in cost estimation).
- Probability of weather delays due to winter-season construction requirements.
- Large distance between the dredge areas and the nearest harbors of refuge and staging.
- The potential for unsuitable material in the borrow areas, including tires, ordnance, and associated requirements for screening.
- Probability of further exclusions to the preliminarily identified borrow areas due to unsuitable material or hardbottom or sedimentation impacts.
- Likelihood that there will be left-over sand available in the adjacent shoreline's borrow areas over which the current project has limited control.

There may also be uncertainty regarding benefit estimates in terms of the value of property protected from storm and erosion damage. The FR/EIS currently uses replacement costs minus depreciation, but market and assessed values could be employed. These alternative valuation methods could incorporate variability in benefit estimation that could proxy for uncertainty over current and future benefits of storm protection. If regression analysis is used to predict property values, parametric uncertainty can be quantified and uncertainty over property values can be incorporated and reflected in this manner.

The influence of climate change induced sea level rise is discussed but it is not clear how this is incorporated into the RU analysis and GRANDUC.

The Cost Engineering Branch Center of Expertise (Walla Walla District) provides detailed cost and schedule risk analysis guidance (USACE 2008a), including development of cost and schedule risk registers and models to conform with Memorandum CECW-CE (1110) (USACE 2007b), ER 1110-2-1302 (USACE 2008b), and EC Bulletin No. 2007-17 (USACE 2007c), which address the requirements for cost risk analysis methods to be used for the development of contingency for Civil Works projects exceeding $40M. These methods involve a formal, prescribed process that includes involvement of the Project Delivery Team (PDT) utilizing Monte Carlo principles. The USACE Jacksonville District provides an example of a more comprehensive Risk & Uncertainty analysis that includes costs of beach nourishment, based on USACE's "Cost and Schedule Risk Analysis Process" manual.

Significance – Medium:

The uncertainty regarding the dredging and beach nourishment costs and statistical variability in recreation benefit estimates (user days and benefits per day) could have a sizeable impact on project net benefits and therefore economic feasibility.

Recommendations for Resolution:

To resolve these concerns, the report would need to be expanded to include:

1. A cost and schedule risk analysis should be conducted, in accordance with EC Bulletin No. 2007-17 (USACE, 2007c), and such as detailed in the "Cost and Schedule Risk Analysis Guidance" (USACE 2008a) from USACE's Cost Engineering Branch Center of Expertise (Walla Walla District). This analysis should consider the likelihood and impacts of risk/uncertainties regarding sand availability, dredging costs, recreation benefits, property benefits, and sea level rise as indicated below.
2. Risk and uncertainty regarding sand availability and dredging costs (beyond the existing 25% contingency factors) need to be included in the risk and uncertainty analysis. Ideally these would be incorporated into the GRANDUC model as integral elements of that model and/or as directed by the Guidance above.
3. Include as an integral part of the GRANDUC analysis, the statistical variability in recreation benefits (value per day and estimated number of visitor days) in the GRANDUC risk and uncertainty analysis.
4. Include as an integral part of the GRANDUC analysis, the statistical variability in property benefits (based on competing estimation methods or uncertainty in estimation) in the GRANDUC risk and uncertainty analysis.
5. Either explicitly incorporate sea level rise into the GRANDUC analysis or explain how it is reflected in the variables such as erosion distance or wave characteristics that are part of the existing GRANDUC analysis.

Literature Cited:

USACE. 2007b. Application of Cost Risk Analysis Methods to Develop Contingencies for Civil Works Total Project Costs. Memorandum CECW-EC (1110), dated July 3, 2007.

USACE 2007c. Engineering and Construction Bulletin: Application of Cost Risk Analysis Methods to develop Contingencies for Civil Works Total Project Costs. CECW-EC Bulletin EC 2007-17, dated September 10, 2007.

USACE. 2008a. Cost and Schedule Risk Analysis Guidance. U.S. Army Corps of Engineers, Cost Engineering Branch Center of Expertise, Walla Walla District.

USACE. 2008b. Engineering and Design: Civil Works Cost Engineering. U.S. Army Corps of Engineers, Washington, DC. CECW-EC Circular No. ER 1110-2-1302, dated September 15, 2008.

Final Panel Comment 14:
The fishery resources discussion should be expanded to include nearshore shellfish species and relationships between Essential Fish Habitat (EFH) and commercial/recreational fishery values.
Basis for Comment:
Characterizations of finfish assemblages in Section 2.01 (subsections 2.01.1 through 2.01.10) are generally thorough, but insufficient information is provided in regard to shellfish (mollusks and crustaceans). According to the discussion in Section 2.01.1 it appears that project area shellfish were considered to be important only in tidal saltwater (estuarine) habitats; however, several of these species, as well as other species of marine decapods and mollusks, are important components of fisheries along the coast and should be addressed in detail in the text. The presentation for Essential Fish Habitat (EFH) is represented primarily by Tables 2.5 and 2.6; although the Main Report does describe habitat types, it does not relate those habitat types back to specific target species provided in the tables. The nature and extent of commercial and recreational use of finfish and shellfish resources should also be discussed. The Main Report presently provides a brief description of commercial landings, and mentions key recreational finfish species (Section 2.04.3) and potential impacts to these finfish fisheries are described briefly in Section 8. However, neither section relates specific project area habitats to fishery resource utilization and value.
Significance – Low:
Further detail on shellfish species and EFH will improve the resource agencies' ability to assess the potential impacts on fishery resources.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: 1. Expand the text in Section 2.01 to thoroughly describe shellfish species that represent important components of nearshore commercial and recreational fishery resources. 2. Provide a discussion of major fishery species and how they are distributed in regard to the types of EFH in the project area.

Final Panel Comment 15:
The FR/EIS should be expanded to address the relevant Federal and State protected species statutes and should be updated to clarify the present status of several species.
Basis for Comment:
Neither the Main Report nor the Biological Assessment (Appendix I) explains key statutes that define the legal status and regulation of activities that may affect protected species, such as Endangered Species Act, Marine Mammal Protection Act, Eagle Protection Act, or State of North Carolina regulations regarding State-protected species. It would be helpful to describe how these various laws/rules would apply to the Surf City project. For example, there is no discussion of what level of protection is afforded to wildlife under North Carolina statute 113-331-350, which defines prohibited acts and penalties. State-protected species that could occur in the project area should be listed. There is no discussion of the Eagle Protection Act; information about Bald Eagle nests (positive or negative) should be presented. Appendix I contains no mention of the smalltooth sawfish occurrence in North Carolina in 1999. This observation was reported by Schwartz in 2003 and was cited by National Marine Fisheries Service in 2009. Discussion of the shortnose sturgeon appears to be based upon a single occurrence in winter 1986-1987, in Brunswick River. The 1999 smalltooth sawfish observation was more recent and should have been the basis for including this species in the Biological Assessment. The FR/EIS should use the standardized common names in the American Ornithological Union (AOU) 1983 checklist of birds (AOU, 1983). Also, Table 2.12 should be updated to include several other State-listed species, and should be consistent with Table 2.7. Table 2.7 is also out of date; the status of Wilson's plover and American oystercatcher was changed to Special Concern (SC) in 2008.
Significance – Low:
A discussion of all applicable statutes and updating the description of protected species will provide a more complete basis for assessing potential impacts on these species.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: 1. Create a new section in Chapter 2 that is devoted to Federal and State protected species. This section should include a discussion of the various statutes that afford protection to the listed species. 2. Appendix I should be updated to address smalltooth sawfish. 3. Tables 2.7 and 2.12 should be updated and checked for accuracy and consistency.

Literature Cited:

American Ornithologists' Union. 1983. Check-list of North American Birds. 7th edition. American Ornithologists' Union, Washington, D.C.

National Marine Fisheries Service. 2009. Recovery Plan for Smalltooth Sawfish (*Pristis pectinata*). Prepared by the Smalltooth Sawfish Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland.

Schwartz, F.J. 2003. Bilateral asymmetry in the rostrum of the smalltooth sawfish, *Pristis pectinata* (Pristiformes: Family Pristidae). J. North Carolina Acad. Sci. 119:41-47.

Final Panel Comment 16:
Historical conditions, including storm impacts and dredged material disposal activities at and near the project area, need to be described more thoroughly due to their influence on future erosion rates and renourishment requirements.
Basis for Comment:
The Main Report and Appendix D (Coastal Engineering) provide relatively little detail regarding prior shore protection activities, storm intensity and frequency, storm erosion impacts along the subject shoreline, and nearby inlet dredging and disposal activity. Table 3.1 lists landfalling storms since 1800, but it provides incomplete data regarding the frequency of storm impacts. There is inadequate data to judge whether the hurricanes of 1996-1999 were a unique, recent, and historically unusual occurrence relative to expected future storm conditions. This, in turn, influences the degree to which the without-project, future erosion rate of 2 ft per year is deemed to represent a reasonable assumption. This erosion rate significantly influences the formulation and evaluation of the project. Section 3.06 makes brief mention of dredged material disposal from New River Inlet, but there is otherwise no mention of the total dredge volume from the inlet nor from New Topsail Inlet. Section 3.07 assumes no allowance for future shore placement of maintenance dredging material from New River Inlet, although the report cites placement of 68,000 cubic yards per year every 1 to 3 years over a 10 year period. Neglecting this disposal material will influence project renourishment requirements, particularly in light of the southerly net transport described by the GENESIS results in Appendix D.
Significance – Low:
Information regarding the historical activities, storms and similar projects at and near the project area is helpful in understanding the scale/severity of the existing problem and the recommended project solution.
Recommendations for Resolution:
To resolve these concerns, the report would need to be expanded to include: 1. Description of the history and volume of dredge and disposal practices at the two adjacent inlets, and the current dredge and disposal plan for sediment (particularly beach-quality sand) from these two inlets. 2. Justification for the exclusion of dredge disposal contributions from at least New River Inlet in the project formulation. 3. Description of the frequency and severity of recent storms (including through at least 2008) relative to the greater historical context.